

Addressing Flood Hazards via Environmental Humanities in Malaysia

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ABSTRACT

Much of the environmental problems facing humanity in the 21st Century are human-created but society has chosen mostly to tackle them via the structural approach, employing science and technical solutions while ignoring the root causes. This structural approach has been used heavily to tackle flood hazards in Malaysia and is found to be ineffective. Since flood causes have their root causes in human society, clearly the most appropriate and effective way to address them is not through science but through tackling the human causes. The study of Environmental Humanities (EH) can provide more effective answers to not only flood but also environmental problems. EH relates to investigating environmental/sustainability issues from the perspective of the humanities. In the modern era, the humanities has been transformed into high-tech areas (as many researches in humanities now integrate the study and use of technology in environmental hazard studies). Consequently, the development of EH is increasingly permeating into all fields. This article examines how EH deals with flood management and the range of contemporary environmental problems resulting from the interactions between humans and nature. More significantly, although floods have evolved to become a common feature in the lives of a significant number of Malaysians, increased exposure and vulnerability were demonstrated to be largely influenced by human activities. Human forces such as socio-cultural, political, economy and institutional are probably more important than natural causes and they need to be researched. The answers to more effective floodplain management is expected to be found in the human dimension rather than the natural sphere. Thus, human contexts need to be identified and understood for more effective flood management. Finally, EH's contribution is to aid understanding that flood problems are multi-causal phenomena, and to develop skills in humans necessary for effective environmental citizenship and leadership in the area of flood management.

Key words: environmental humanities, flood hazards, flood management, human activities, environmental citizenship

ABSTRAK

Banyak masalah alam sekitar yang dihadapi manusia pada abad ke 21 ini disebabkan oleh manusia sendiri, tetapi masyarakat sebahagian besarnya memilih untuk menanganinya melalui pendekatan kestrukturkan dengan menggunakan sains dan penyelesaian teknikal dan mengabaikan penyebab asasnya. Pendekatan kestrukturkan ini telah digunakan dengan banyaknya untuk mengatasi bencana banjir di Malaysia dan didapati tidak berkesan. Oleh kerana penyebab banjir berakar umbi dalam masyarakat manusia, amat jelas langkah paling tepat dan berkesan untuk mengatasinya bukanlah melalui sains, tetapi dengan menangani penyebab manusia. Kajian tentang Kemanusiaan Persekitaran boleh menawarkan jawapan yang lebih berkesan bukan hanya untuk banjir tetapi juga masalah alam sekitar. Kemanusiaan Persekitaran dikaitkan dengan penyelidikan tentang isu-isu persekitaran/ kelestarian dari perspektif kemanusiaan. Dalam era moden ini, kemanusiaan telah ditransformasikan kepada bidang teknologi tinggi (kerana ramai dalam kalangan pengkaji kemanusiaan kini mengintegrasikan kajian dengan menggunakan teknologi dalam kajian-kajian bencana alam sekitar). Dengan itu perkembangan persekitaran kemanusiaan telah menular ke dalam banyak bidang. Artikel ini meneliti bagaimana kemanusiaan persekitaran digunakan dalam pengurusan banjir dan beberapa masalah alam sekitar semasa hasil interaksi antara manusia dan alam semula jadi. Lebih-lebih lagi, walaupun banjir telah menjadi perkara biasa kepada kehidupan ramai rakyat Malaysia, pendedahan dan keterancaman yang bertambah jelas menunjukkan ianya dipengaruhi oleh aktiviti manusia. Penyebab manusia seperti sosio-

budaya, politik, ekonomi dan institusi mungkin lebih penting berbanding penyebab-penyebab semula jadi dan perlu dikaji. Jawapan kepada pengurusan dataran banjir yang lebih berkesan dijangka dapat ditemui dalam dimensi manusia dan bukannya alam semula jadi. Oleh itu, konteks manusia perlu dikenalpasti dan difahami untuk pengurusan banjir yang lebih berkesan. Sumbangan kemanusiaan persekitaran adalah untuk membantu kefahaman bahawa masalah banjir adalah suatu fenomena pelbagai penyebab, dan untuk membentuk kemahiran manusia yang penting dalam kewarganegaraan persekitaran dan kepemimpinan dalam pengurusan banjir.

Kata kunci: kemanusiaan persekitaran, bencana banjir, pengurusan banjir, aktiviti manusia, kewarganegaraan persekitaran

INTRODUCTION

In the modern world, science is acknowledged by the vast majority of humanity as the panacea to solving all problems, including environmental woes afflicting much of the human race now. Yet, despite its advancements in all spheres, it is a well-known fact that science alone cannot solve all of humanity's problems. In fact, much of humanity's problems are caused by science when science is badly managed or abused. Much of the environmental problems facing humanity in the 21st Century are human-created but society has chosen mostly to tackle them via the application of scientific solutions, i.e. employing science and technical solutions via a structural approach while ignoring the root causes. This structural approach has been used heavily to tackle flood hazards in Malaysia and has been found to be largely ineffective (Chan 1995a, Chan 2002). Since flood causes have their root causes in human society, clearly the most appropriate and effective way to address them is not through science but through tackling the human causes (Chan 2009). The study of Environmental Humanities (EH) can provide more effective answers to not only flood but also environmental problems. EH relates to investigating environmental/sustainability issues from the perspective of the humanities. In the modern era, the humanities has been transformed into high-tech areas as many researches in humanities now integrate the study and use of technology in environmental hazard studies (e.g. computers, cell phones, PDAs, GPS, Digital Humanities, etc). Consequently, the development of EHs is increasingly permeating into all fields. This paper examines how EH deals with flood management and the range of contemporary environmental problems resulting from the interactions between humans and nature. Finally, EH's contribution is to aid understanding that flood problems are multi-causal phenomena, and to develop skills in humans necessary for effective environmental citizenship and leadership in the area of flood management.

The word "Humanities" in EH here refers to all fields that are not science or science-based. For example, the School of Humanities in Universiti Sains Malaysia (USM) is championing the development of EH, first as a research cluster involving philosophy, history, geography, literature, languages, literacy and translation, Islamic studies, and other fields of humanities (Chan 2009). Other non-science Schools in USM such as Social Science, Communications, Fine Arts, Housing, Building and Planning, Education, Management, Computer and ICT, are also involved in EH studies. Hence, EH is Interdisciplinary and Transdisciplinary. Interdisciplinary means researches, studies and projects that involve several unrelated academic disciplines in a way that forces them to cross subject boundaries to create new knowledge and theory and solve a common research goal. Unrelated means that they have contrasting research paradigms – e.g. the differences between qualitative and quantitative approaches or between analytical and interpretative approaches that bring together disciplines from the humanities and the natural sciences. Different fields work together towards a common objective. Healthy, collaborative research have always been a major key to success in any research/work as it gives more accurate and comprehensive results. Interdisciplinary research is necessary due to rapid development of global telecommunication networks and media, resulting

in a global trend to network and collaborate across traditional boundaries of sector, geography, discipline, and religion. Perspective of community towards environment and its relation to their beliefs and practices (geography, religious studies, sociology, ethics, etc). Perspective of local community towards global issues (e.g. global warming) and how it impacts people's lives (management, communications, geography, law, religion, education, etc). Building design and planning (traditional architecture) in local literature, culture and beliefs (housing, building and planning, literature, sociology, cultural studies, religion, computer, etc). Local wisdom on sustainability (cultural studies, management, history, development studies, philosophy, etc).

The literature of environmental management indicates that environmental problems facing humanity in the 21st Century are largely human-created (e.g. global warming, acidification of rain, pollution, loss of biodiversity, species extinction, urban heat island, haze, photochemical smog, flood and drought, etc.). Weakness/fallacy of the structural approach - employing science and technical solutions to solve human created problems while ignoring the root causes. This approach is ineffective as science does not hold all answers to all humanity's problems. The EH approach - since environmental problems have their root causes in human society, clearly the most appropriate and effective way to address them is not through science but through tackling the human causes via the humanities. This is where the study of Environmental Humanities and EH is most vital and relevant in now. Classical works of environmental studies - all in EH: Carson (1962), Hardin (1968) and Odum (1953). In History, civilisation collapse primarily caused by inability to address human causes with solutions in EH (Ponting 1991; Diamond 2005). EH is highly relevant as it provides effective solutions to environmental disasters.

EH can be an Inter-disciplinary Approach to Sustainable Development via gaining an understanding of ways to balance social and economic needs with environmental realities. Researchers in EH learn how to use resources imaginatively for sustainable development, and create greater awareness of the role of values in issue formulation and policy making. They also develop basic literacy in the natural and social sciences and the humanities as they contribute to an understanding of environmental affairs. They also critically analyze environmental problems and identify, research, and evaluate environmental problems. The study of EH can also be transdisciplinary in the sense that researches, studies and projects both integrate academic researchers from different unrelated disciplines and non-academic participants, such as land managers and the public, to research a common goal and create new knowledge and theory. Transdisciplinarity combines interdisciplinarity with a "participatory approach" as different fields work together to create a new field/sub-field. In a world of globalization, environmental, social, economic and cultural crises are no longer 'other people's problems' and 'out of site and out of mind' but become almost everybody's problems. The world has increased in Complexity - EH is needed to engage with the incredibly complex nature of the crises facing humanity (e.g. climate change, poverty and conflict are interwoven, and caused by thousands of different actions at one level and on another spawned from a way of thinking that has dominated humanity globally. To deal with these issues effectively, research need to join and transcend current disciplines rather than be formed within each of them separately.

ENVIRONMENTAL HUMANITIES AND FLOOD HAZARD MANAGEMENT IN MALAYSIA

In Malaysia, the risk of flooding affects a significant section of its population. As floodplains are rapidly developed and being encroached upon, more and more people and property (including public infrastructure, communications and private industries and businesses) are exposed to flood risk (JICA 1982). As population pressures build up in floodplains, the capacity for public response is diluted and reduced, and this increases vulnerability. Floodplain occupants are also largely from the lower income groups (Chan 1995b), and they are the most vulnerable sections of Malaysian society when affected by flood hazards. Floods are a major natural hazard affecting

many parts of Malaysia, especially in cities (Jamaluddin Md. Jahi 1985). Early settlements prospered on the banks of major rivers in the peninsula. As they grew, floodplains became more developed and densely populated. A combination of population pressures and deterioration of physical conditions resulted in floods becoming more and more of a serious hazard. Both the 'natural/physical events system' such as monsoon winds, heavy seasonal rainfall, low-lying topography, river characteristics, drainage etc. and the 'human use system' such as agriculture, housing, commerce, deforestation, floodplain encroachment etc. interact in the creation and perpetuation of flood hazards in Malaysia (White 1945). In recent decades, the pace of economic development is rapid, as is the pace of technological change. The country has experienced rapid economic development in agriculture, mining, industries and urbanisation (as well as other fields) since independence in 1957. Rapid economic growth rates of 8.0 per cent or more in the last decade (*The Economist* July 1994: 61) and the country's incessant push towards industrialisation (Government of Malaysia 1991), have all contributed to changing much of the natural system. Other things being equal, these developments have significantly contributed to disturbed hydrological regimes and other parameters relating to flood occurrences (Chan 2004). Flood hazards are, therefore, being reinforced and perpetuated largely through human interference which can lead to their amplification. These developments may be described as rapidly changing contexts. As these contexts change, natural/physical systems are affected and they change accordingly, giving rise to increased flood risk, exposure and vulnerability amongst those living on floodplains (Parker et al. 1997).

Flood hazards and disasters are, therefore, neither solely the work of nature nor are they solely caused by humans, but result from the interaction of both the natural events system and the human use system. Notwithstanding the favourable natural conditions which foster the occurrence of floods in the peninsula, human factors are becoming increasingly more influential in flood hazard creation. This is especially so in the outcome of flood hazards and their translation into disasters. While both natural and human factors contribute to the occurrence of flood hazards and disasters in the peninsula, human factors are becoming increasingly more influential. This is especially so in the outcome of flood hazards and their translation into disasters. The flood enhancing characteristics of the natural events and human use systems in Malaysia are demonstrated by Chan (1995a) from four selected flood-prone areas of Kuala Lumpur, Pulau Pinang, Pekan and Kelantan. Although natural conditions in the peninsula favour the creation of floods, flood hazards are fundamentally the consequence of human action. More significantly, however, is the fact that risk, exposure and human vulnerability to flood hazards are all increasing largely because of activities in the human use system which contribute to and reinforce their creation and perpetuation. Flood hazards are, therefore, more of a consequence of human action (e.g. through the mismanagement of flood related activities) than they are by naturally inducing factors. Malaysians are historically a riverine people as early settlements grew on the banks of the major rivers in the peninsula. Coupled with natural factors such as heavy monsoon rainfall, intense convection rain storms, poor drainage and other local factors, floods have become a common feature in the lives of a significant number of Malaysians. Floods are the most common 'natural hazard faced by the inhabitants of Malaysia. On the national scale, the flood hazard accounts for almost the entire reported annual cost for disaster preparedness, mitigation, relief and rehabilitation. Furthermore, flood hazards are often amplified into flood disasters through human mismanagement (either via ineffective public flood reduction schemes or inappropriate response from the people at risk) (Chan 1998).

RESEARCH METHODS

This study is largely based on a literature review of flood hazard studies in Malaysia and elsewhere in relation to environmental humanities. Secondary data, research reports, journal articles and other reports on flood hazard management form the basis of analysis. The writer also uses his extensive experience and research in the field of flood hazard research by

summarizing the results of his two decades of research on flood hazard management. The analysis is also based on qualitative survey of key informers such as flood hazard institutions, flood managers, flood victims and flood hazard researchers. This paper also examines the extent to which the natural and human use characteristics have contributed to the creation and perpetuation of flood hazards in Malaysia. It analyses flood risk, flood exposure and human vulnerability to flood hazards. Examples from key flood-prone case study areas in the peninsula are used as examples to substantiate the extent to which rapid economic development has exacerbated flood hazards in the peninsula. The analysis is supported by results from qualitative interviews with flood prone households undertaken recently in 2009.

ENVIRONMENTAL HUMANITIES IN RELATION TO FLOOD HAZARD CREATION AND PERPETUATION

There are probably as many human uses as there are floods in relation to flood hazard creation and perpetuation in the peninsula. It is impossible to examine all these uses but key human uses which are closely associated with flood hazards are examined in detail. *Deforestation* is a sensitive issue which has caused much controversy between the affluent North and the developing South. This problem is further complicated by inconclusive research results tying deforestation to increasing flood occurrences. Yet, the issue cannot be ignored as the conversion of natural forest into human land use can be detrimental on hydrological parameters even though flood peaks may not yet be correlated to the proportionate increase in deforestation. Malaysia is a land naturally well endowed with its dense equatorial rainforest which until today is still a commercially important natural resource. The economy of the country is still very much dependent on its forestry products. In 1990, total commercial tree felling in the peninsula amounted to 11 million cubic metres, with sawn timber alone contributing a total value of RM2,520.9 million (Government of Malaysia 1991: 93). In the past, uncontrolled logging has given rise to a rate of deforestation which has threatened not only the ecology of the rainforest but more significantly increased runoff and erosion (on the regional scale) and contributed to warming of the atmosphere (on the global scale) (World Rainforest Movement 1991). Due to extensive exploitation of the peninsula's forests either through logging, agriculture and other land use, less than 70.0 per cent of its total land area is now under forest.

Forest cover is a natural form of flood prevention (Cai et al. 2001). In Malaysia, deforestation is a controversial issue (Sahabat Alam Malaysia 1992; Malayan Nature Society 1992). The dense evergreen equatorial forest of the peninsula protects the top soil from splash erosion and overland flow through its thick, multi-layered structure, undergrowth and litter layer. Natural forest also absorbs part of the rain water during and after a rain event, leaving only a portion of the rain water into the streams. Finally, interception of the rainfall by the forest canopy, tree trunks, branches, undergrowth and leave litter increases the lag time by which the rain water reaches the streams. All the above factors have significant implications for flood occurrences. For instance, forest conversion and logging of commercial trees have been shown to have disastrous consequences on soils and the hydrological regimes (Friends of Penang Hill 1991; Hamirdin 1992). Research has also revealed that significant water yield increases occur after deforestation (Abdul Rahim & Harding 1992). For example, Abdul Rahim (1990) showed that logging in the peninsula has substantially increased water yield between 55.0 per cent to 70.0 per cent (unsupervised logging) and between 28.0 per cent to 44.0 per cent (supervised logging with conservation measures). The DID (1986, 1989) has also shown that clear-cutting of dipterocarp forest resulted in a water yield increase of 822 mm (470.0 per cent), 793 mm and 476 mm in the first, second and third years respectively. Zulkifli and Abdul Rahim (1991) found that there is a water yield increase of between 3 mm to 5 mm for every percentage of forest cover cleared. Toebe and Goh (1975: 10) showed that logging activities caused significant changes in flood peaks, flood volumes and flood frequencies. The government is aware of the importance of its forests both as an economic resource as well as an ecological safeguard against environmental

degradation. It is now pursuing a policy of 'sustainable development of natural resources'. In its Sixth Malaysia Plan (1991-1995), the growth rate for sawn logs is estimated at -6.7 per cent. This negative growth rate is in line with its efforts in protecting and regenerating its forest as well as in protecting the environment and control floods. However, despite this policy of sustained yield and conservation, poor enforcement of its policies (resulting in illegal logging) may yet see the trend of uncontrolled deforestation continue in the future (Hani Ahmad 1991).

Floodplain encroachment is yet another form of human use which is at once prominent and yet hard to curb. Successful modernisation and growth in a developing country like Malaysia brought growth to the urban sector with accompanying problems of urban unemployment, squatters and slums (Faaland et al. 1990: 299). Since independence, there has been a rapid development of the country's urban areas accompanied by a general rise in education level, especially among the children of rural inhabitants. Education is provided free to all Malaysians by the government. The NEP⁸ also emphasised improving the status and standard of living among the Malays and most Malay school children get some form of scholarship. This has resulted in an influx of young rural migrants into the major urban centres for education and employment (Muhammad Razha 1978). While this influx has initially solved some of the problems of labour shortages, it has now become a significant problem not only because it has exacerbated urban unemployment (Khor 1987: 63-70) and put great demands on housing and other public services, but more significantly because it enhances floodplain encroachment and exacerbates flood hazards. According to Faaland et al. (1990: 301), a net exodus of at least 375,000 Malays and 300,000 non-Malays migrated from rural to urban areas over the period 1967 to 1985. Some of these migrants may have moved directly into modern urban employment, but the majority of them are forced into the low-productivity, high unemployment, increasingly over-populated traditional urban sector. For housing, the majority of migrants end up in low priority areas such as ex-mining land, hill slopes, and on flood-prone riverine areas (see analysis on squatter settlements below). Rural-urban migration has, therefore, increased floodplain encroachment and increased the flood vulnerable population. Rapid urbanisation (induced by rural-urban migration) is a key factor in the growth of vulnerability, particularly amongst low-income squatters (Davis 1981, 1987; Blaikie et al. 1994). People continue living in riverine squatter settlements in the cities despite recurrent flooding simply because it is the only place they can afford to live in. Rural-urban migration can, therefore, be considered a structural force partly responsible for the creation and perpetuation of people on floodplains. With the rapid development of the economy in recent years, rural-urban migration is expected to have increased significantly bringing with it an even greater threat to urban floodplain encroachment.

In Malaysia, Radiah Yusof et al. (2004) conclude that squatting is a major structural force which creates and exacerbates urban flood hazards. It results from a combination of poverty, landlessness, rural-urban migration (to search for better paying jobs), influx of illegal immigrants (mostly Indonesians and Thais) and other structural causes. Since urban floodplains are probably the only vacant space left undeveloped in the cities, squatters inevitably occupy these hazardous flood-prone areas, and consequently become exposed to flood hazards. In urban areas, squatters are the most vulnerable group of people as they are amongst the poorest in Malaysian society, and least able to recover from a flood disaster. Squatting is both a historical as well as a modern phenomenon. During the colonial period, squatters were mainly immigrant Chinese and Indians but after independence, squatting by Malays due to rural-urban migration, also became a problem (Azizah Kassim 1982). In 1957, one out of three persons in Kuala Lumpur (the federal capital) was a squatter and there were as many as 20,000 squatter families (Fish 1957). By 1980, there were 48,709 squatter families in Kuala Lumpur and it has been estimated to increase at a rate of 9.7 per cent per annum (Dewan Bandaraya Kuala Lumpur 1982). Wan Abdul Halim (1982) has identified 202 squatter settlements in Kuala Lumpur, the majority of which lie on flood-prone areas near the main rivers running through Kuala Lumpur. Squatting in Kuala Lumpur is only one example. All the major urban centres in Malaysia have squatter settlements. For example, Ipoh (Perak state), Johor Bahru (Johor state) and Prai (Pulau Pinang state) have approximately 60,000,

50,000 and 20,000 squatter families respectively (Khor 1989). Squatting on flood-prone areas in the major in Malaysia urban centres is a social problem facing the authorities. Squatters live in the most hazardous of floodplains simply because they are too poor to live any where else. In the current study, it was found that 62.9 per cent of squatter households in Malaysia were flooded 10 times or more in the last 10 years compared to 43.3 per cent of non-squatter households. Perhaps the story of Abdullah from Kampung Bumiputra in Kuala Lumpur (see below) demonstrates the extent to which squatting has increased floodplain encroachment and in the process contributed significantly to increased flood risk, exposure and vulnerability amongst urban floodplain occupants. More significantly, flood hazards are exacerbated due to activities originating from the human use system.

The example of Kuala Lumpur perhaps epitomises the extent to which urban floodplains have been occupied, thereby increasing risk, exposure and vulnerability. From a meagre population of a few hundred miners when it was first founded in 1857 (at the confluence of the Gombak and Kelang rivers), Kuala Lumpur's population has grown to 1,145,075 in 1991 (Department of Statistics Malaysia 1992: 125). With ever increasing development and urbanisation, the federal capital's population is expected to increase further in the near future. Although the government has given an estimated figure of 2.4 per cent (average annual growth rate) over the Sixth Malaysia Plan period (Government of Malaysia 1991: 28), Kuala Lumpur's rate of population increase is expected to be much higher than the national average⁹. According to the Kelang Valley Perspective Plan, the population of the Kelang Valley (of which Kuala Lumpur occupies the middle and part of the lower sections) is estimated to reach 4,760,000 by the year 2000. Kuala Lumpur's population is projected to reach 2.2 million by the year 2000 and a significant proportion is expected to occupy floodplains as land become scarce, thereby increasing exposure and vulnerability. Property development is also expected to increase flood damage potentials.

ROLE OF ENVIRONMENTAL HUMANITIES IN INCREASING FLOOD RISK, EXPOSURE AND HUMAN VULNERABILITY

In Malaysia, it has been estimated that approximately 2.5 million people live in floodplains and are exposed to *flood risks* of varying probabilities (JICA 1982: 14). While 'risk' may be defined as the probability and other physical characteristics of hazards, it is essentially a product of hazard and vulnerability as 'there is no risk if there are hazards but vulnerability is nil, or if there is a vulnerable population but no hazard event' (Blaikie et al. 1994: 21). Heavy monsoonal and convectional rainfall, flat topography on both coasts, heavy siltation of rivers, and human activities have all contributed to high flood risk. Risk is increasing because flood characteristics are changing due to rapid urbanisation of catchments (Yaziz & Sulaiman 1985; Friends of Penang Hill 1991; Hamirdin 1992). Deforestation and other environmentally damaging human land uses have also significantly altered hydrological parameters. Research has revealed that significant water yield increases occur after deforestation (Abdul Rahim 1988, 1990; Abdul Rahim & Harding 1992), and that commercial logging resulted in significant increases in storm flow volume and initial discharge (DID 1986). Other human activities such as tin mining have also contributed to flooding. Climatic change inducing sea level rise may also be an important flood inducing mechanism which can increase future flood risk (Parry et al. 1992). Flood reports for the period 1925 to 1993 (Chan 1995b) also suggest that flooding has become progressively more frequent, with flash floods mainly affecting the federal capital and Pulau Pinang. Flooding magnitudes have also appeared to have increased since the 1970s (a period of rapid economic development) in the East Coast states. The physical contexts of floods have, therefore, changed. Together with greater exposure and vulnerability of human populations (see below), it has contributed to increased flood risk.

Floodplains are also regions where a significant proportion of the country's population and much of the economic activity are concentrated (Leigh & Low 1978: 49). The three largest urban

centres in the country are located on floodplains and are susceptible to frequent flooding. In addition, five of the top ten urban centres and more than half of all urban centres are located on flood-prone areas. Thus, the exposure of population and property such as infrastructure, economic activities and industries in the country is high. *Exposure* is, therefore, a measure of the population at risk. As Malaysia's major cities grew they spilled onto floodplains progressively increasing flood exposure (Chan & Parker 1996) and flood damage potentials. Some prominent examples are the rapid development of the Kuala Lumpur-Petaling Jaya-Shah Alam-Kelang conurbation and rapid industrialising Georgetown. Expansion in existing urban areas (the majority of which are already on floodplains) due to population expansion and rural-urban migration have also forced people to inhabit the more hazardous parts of existing floodplains. A 'classic' result of urban encroachment of floodplains is the growth of a large squatter population in the major urban centres (Wan Abdul Halim 1982).

Urbanisation may well accelerate in the near future as Malaysia pushes further towards goals of rapid development and income equity. The Malaysian economy has grown by over 8.0 per cent per year from 1988 to 1993 and indications and projections point to it at least maintaining that momentum over the medium term (*The Economist* July 1994: 61). With such a rapid growth rate existing urban areas will expand and many rural areas will be transformed. Also, the government's policy for greater income opportunity and equity amongst the various ethnic groups may well force the predominantly rural Malays to abandon their traditional padi (paddy) farms and to move into jobs in urban centres. According to Mahathir Bin Mohamad (1970: 107-114), the current prime minister, the Malays must be urbanised and encouraged to migrate to urban centres (mostly dominated by Chinese), to stand any chance of catching up with the other ethnic groups. All of these impending developments will undoubtedly lead to further swelling of urban population, thereby exacerbating the pressures for floodplain encroachment in urban centres located on or adjacent to floodplains. The rate of urbanisation in Malaysia has increased more than four fold from 10.7 per cent in 1911 to 50.0 per cent in 1995 and the number of urban centres has also increased from 8 in 1911 to more than 100 in 1995 (Chan & Parker 1996). For example, the federal capital of Kuala Lumpur is expected to merge with the nearby urban centres of Petaling Jaya, Shah Alam and Kelang into a continuous conurbation stretching the entire length of the Kelang River valley by the year 2020 (JICA 1982). It is expected that the total urbanised area in the Kelang valley would be about 44.0 per cent in the year 2005 but the middle section of the valley around this conurbation would be 80.0 per cent urbanised (JICA 1989: pD-17). Urbanisation results in replacement of forests with impervious urban surfaces and this causes increase in surface runoffs resulting in floods (Chan & Wan Ruslan Ismail 1997; Sathiamurthy et al. 2007).

If *vulnerability* is the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of a natural disaster' (Blaikie et al. 1994: 9), then Malaysia is a prime example where high and increasing vulnerabilities are found. The outstanding feature of the country is its wide disparity in regional development (mainly between the East Coast and West Coast states) and its extremely variegated ethnic mix which also exhibit significant differences in incomes. Those who find it hardest to recover from a flood disaster and reconstruct their lives are the most vulnerable, and these are generally the poor. And because those who occupy floodplains are the poor (comprising peasant farmers and fishermen in rural areas and squatters in urban areas), they are the most vulnerable. Thus, the poverty syndrome is directly related to vulnerability (Davis 1978: 11, 1981: 14). Increased vulnerability to flood hazards in Malaysia, therefore, is caused fundamentally by poverty and is persistently reinforced by increased flood risk and exposure. Vulnerability, however, should not be simply equated with poverty. There are other causes such as class, caste, gender, ethnicity, disability, and age or seniority, and vulnerability is produced by a combination of these factors and the economic resilience (i.e. access to resources and poverty) of people (Blaikie et al. 1994: 9; Cannon 1993, 1994: 27). In practice, however, it is the poor who suffer the most in a disaster (Cuny 1983; Davis

1984; Varley 1994), and flood disasters may be found at the interface between flood hazards and vulnerable conditions (Davis 1984).

Poverty due to the lack of access to resources is a fundamental cause of hazard vulnerability amongst specific groups in society, and is a central theme in vulnerability studies (Davis 1978, 1984; Blaikie et al. 1994; Cannon 1994). In Malaysia, poverty is one of the main reasons why many people persist on hazardous floodplains. Chan (1995a) has demonstrated how contextual forces have created poverty and perpetuated flood hazards in the country. The Government of Malaysia (1991 p12) reports that the current poverty level in the country is still significantly high at 17.1 per cent. Most of the poor households are located in the remote traditional kampungs (mostly Malays), deteriorating rubber plantations (mostly Indians), new villages (mostly Chinese) and squatter settlements in urban areas (mixed ethnicity). Poverty is a structural problem initially generated by colonial neglect but presently reinforced by ineffective public policies and over-emphasis on economic development of urban areas vis-a-vis rural areas. In the context of the flood hazard, because poor areas roughly coincide with flood-prone areas, the majority of floodplain inhabitants in the country are either poor or living close to the poverty level (Chan 1995b).

Chan (1995a) showed that nearly two-thirds of all flood victims are either poor or living close to the poverty level. A majority of those who had no locational choice are from the lower income group, with 61.4 per cent earning monthly incomes less than RM750 and 43.9 per cent earning monthly incomes less than RM500. Considering that the 1993 poverty level is estimated at RM394 (Chan & Parker 1996), a significant proportion of those who had no choice in location are either poor or are living on the margin of poverty. Research results from this study indicates that households from East Coast areas are comparatively poorer than their counterparts from West Coast areas. Therefore, households from the East Coast who are also more exposed to flood hazards, are expected to be more vulnerable to flood hazards compared to those from the West Coast. The capacity to anticipate, cope with, resist and recover from the impact of flood hazards depends largely on an individual or household's economic situation. Generally, the wealthier ones are less vulnerable because they have a greater capacity (at least economically) to withstand floods. Accumulated wealth enables them to survive and recover with ease. In the worst scenario, they have the option to move or migrate. In contrast, the poor are the most vulnerable simply because of their limited ability and resources in the face of flood disasters. Thus, on the basis of the high levels of poverty amongst floodplain inhabitants, vulnerability to flood hazards is consequently high. Thus, human use of floodplains are largely responsible for increasing risk, exposure and vulnerability to flood hazards in Malaysia.

CONCLUSION

In Malaysia, attributes and characteristics of the 'natural/physical events system' such as monsoon winds, heavy seasonal rainfall, low-lying topography, river characteristics, drainage etc. are demonstrated to be conducive to flood occurrences. Therefore, it cannot be denied that the natural system contributes significantly to flooding in many parts of the country. However, despite the influence of the natural system, it was shown that it was the combined action of both the natural and human systems that contribute to flood hazards. More significantly, this study has demonstrated that attributes from the 'human use system' such as deforestation, floodplain encroachment, squatting and other forms of human land use are more important in flood hazard creation and perpetuation. Rapid growth in terms of physical and economic development, and population pressures in recent decades in many parts of the country has increased the frequency of flooding, resulting in various problems and unprecedented damages.

Current rapid development of urban floodplains have also exacerbated flood problems resulting in high potential flood damage in such areas. The debate on deforestation is still unresolved as research relating flood occurrence to deforestation has been inconclusive. Yet, to treat deforestation as insignificant would be dangerously naive as deforestation has certainly

changed hydrological parameters and contributed to flooding, especially that of urban flash flooding. This paper concludes that a combination of natural and human factors have contributed to increasing flood hazards in Malaysia. While natural characteristics such as exposure to cold surges and monsoon depressions leading to heavy seasonal rainfall, intense convection rain storms, low-lying topography, poor drainage and other local factors are responsible for high flood risk in many parts of the country, inadvertent and deliberate human use of floodplains (both past and present) such as padi farming, plantation agriculture (mostly rubber and oil palm), tin mining, city and town expansion and others have resulted in increased human and material exposure and vulnerability.

More significantly, although floods have evolved to become a common feature in the lives of a significant number of Malaysians, increased exposure and vulnerability were demonstrated to be largely influenced by human perception and activities (Jamaluddin Md. Jahi & Ismail Ahmad 1983). Human forces such as socio-cultural, political economy and institutional are probably more important than natural causes and they need to be researched. The answers to more effective floodplain management is expected to be found in the human dimension rather than the hitherto over-emphasised natural sphere. Thus, human contexts need to be identified and understood for more effective flood management. People are probably more likely to be trapped on floodplains by socio-cultural and political economy forces (amongst others) than they are by natural forces. Currently, floodplain occupants in Malaysia are likely to be constrained in their selection of residential location because of poverty, low occupational mobility, low educational attainment and other human forces. These are, therefore, forces responsible for trapping individuals on floodplains, thereby increasing their risk, exposure and vulnerability to flood hazards. Future research directions should, therefore, focus on human forces as they are largely under-researched and ignored in the past. Thus, research evidence indicates that flood risk, exposure and vulnerability are all increasing in Malaysia. With the rapid economic, industrial and agriculture development expected to be sustained, the country's urban and rural floodplains are expected to grow. More people are expected to live in flood zones as encroachment becomes an inevitable solution to population and land pressures. Greater exposure and vulnerability will lead to greater damage potentials and exacerbation of flood hazards.

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